

MDA Horticulture Fund: Project Report

Biological Control of Japanese Beetle In Michigan Through Parasite and Pathogen Introduction

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Team Members:

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Type of Project (check one)

- ☒ Continuation of FY-06 project
☐ Continuation of FY-07 project
☐ New FY-08 proposal

Program Area (check only one)

- ☒ Applied Research
☒ Basic Research
☐ Extension/Demonstration

Accomplishments in 2007:

At each of the 10 golf course study sites Japanese beetle grubs were collected in the spring and fall from 16 locations along the edge of the original fairway (inoculated or control, depending on the golf course), and from 16 locations along a different fairway located from 50 to 150 m away. Forty grubs from each fairway were dissected to determine percent infection by *Ovavesicula popilliae* and milky disease. Japanese beetle adults were collected from each golf course in late July and early August using a standard Japanese beetle trap baited with eugenol. At least 60 adults from each fairway were dissected and examined for infection by *O. popilliae*. In addition, the ovaries were removed and developing eggs counted to determine effects of infection on the reproductive ability of females.

Results in 2007: *O. popilliae* infection of Japanese beetle grubs continued to increase at sites where it was introduced in 1999 and 2000 (Table 1). At Orchard Lake and Willow golf courses, where *O. popilliae* appears to have originated as a result of our introductions into a 100 m² plot area in 1999 and 2000, the infection of grubs has spread up and down the entire length of a fairway and into adjacent fairways. Infection levels at those sites have now increased to >30%, a level expected to have a significant impact on the density of grubs in that population. In 2007, adults were dissected and examined for *O. popilliae* infection for the first time. At sites where *O. popilliae* was previously found in grubs, the infection level of adults ranged from 5 to 30% (Table 2). This rate of infection of adults will allow *O. popilliae* to spread at least a ¼ mile per year, because adults frequently fly that far. Determining the infection level of adults also gives us the opportunity to collect beetles from sites where the pathogen is active for introduction into areas where it has not yet been found. Collecting adult beetles will be much easier than digging grubs like we have done in previous years. The impact of *O. popilliae* infection on Japanese beetle populations was measured by determining the survival of grubs from fall of 2005 to spring of 2006. At golf courses where more than 5% of the grubs were found to be infected, the decrease in grub density from fall to spring was 57.4% compared with 28.2% at sites where no *O. popilliae* was found (Table 3, Figure 1). The same type of analysis on the impact of *O. popilliae* on the survival of grubs is now in progress for the winters of 2006 – 07 and 2007 – 08 .

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Table 1. Infection of Japanese beetle grubs with *O. popilliae* from 2005 to 2007 at golf course study sites where introduction and control sites were first sampled in 2000. *O. popilliae* apparently established naturally in the Kalamazoo and Battle Creek area (Binder Park, Eastern Hills and Kalamazoo CC) but in Southeast Michigan it was only found where we introduced it in 1999 and 2000 (Orchard Lake, Willow, Bloomfield Hills). Fairways where *O. popilliae* was introduced in 2000 are indicated with a '+'.¹

Golf course site	<i>O. popilliae</i> release site	Fall 2000	Fall 2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007 ¹
Medalist #5			7	0	0	7	0
Medalist #4	+	0	0	0	0	27	13
Binder Park #18			51	53	52	75	11
Binder Park #6		0	31	28	44	60	-
Eastern Hills #7			43	42	13	13	-
Eastern Hills #5	+	20	17	22	24	13	-
Kalamazoo #15			17	13	64	0	-
Kalamazoo #1		6	20	11	41	16	-
Bloomfield #13			0	0	0	0	-
Bloomfield #6		0	0	0	0	-	-
Willow #9	+	0	7	6	43	0	45
Willow #10			0	0	8	0	2
Orchard Lk #10			0	0	0	0	8
Orchard Lk #15	+	0	13	9	30	11	28

¹Percent infection data is not available for fall 2007 at sites where less than 10 grubs were found per fairway. Populations were low at Bloomfield Hills and Kalamazoo County Club because the superintendents treated all the fairways and roughs with insecticide. A low density of grubs at Eastern Hills and Binder Park golf courses may be due to a combination of weather conditions and a high rate of *O. popilliae* infection. Data analysis is in progress to investigate this.

Table 2. Infection of Japanese beetle adults by *O. popilliae* in July, 2007. A total of 60 adults from each fairway were collected from traps and dissected to determine percent infection.

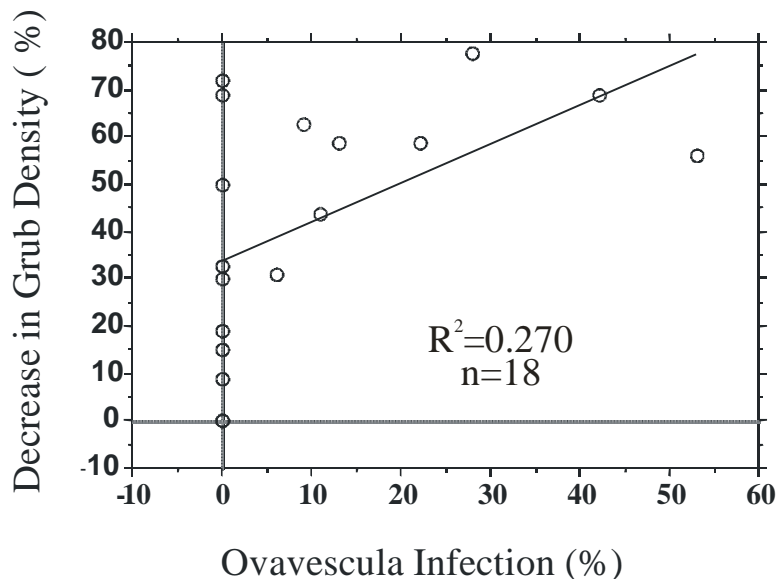
Golf course site	<i>O. popilliae</i> Introduction site	% Infection of adults in week 1	% Infection of adults in week 2
Medalist #5		0	3
Medalist #4	+	0	15
Binder Park #4		10	17
Binder Park #6		3	0
Eastern Hills #7		20	20
Eastern Hills #5	+	10	3
Kalamazoo CC #15		3	13
Kalamazoo CC #1		13	ND ¹
Bloomfield Hills#13		0	ND
Bloomfield Hills#6		0	0
Willow #9	+	0	ND
Willow #10		0	ND
Orchard Lake #10		3	0
Orchard Lake #15	+	23	13

¹Adults collected from these sites have not yet been dissected for diagnosis.

Table 3. Impact of *Ovavesicula* infection on survival of Japanese beetle grubs from fall 2005 to spring 2006.

Activity of <i>O. popilliae</i>	No. of sites	Mean % <i>O. popilliae</i> infection	Decrease in grub density (%)
Plots with no <i>O. popilliae</i>	10	0	28.2
Plots with > 5% infection	8	23	57.4

Figure 1. Decrease in Japanese beetle grub density from fall of 2005 to spring of 2006 in relation to percent infection by *Ovavesicula popilliae* at golf course study sites in Michigan.



Project activities:

In 2008, the final year for this project, Japanese beetle populations, pathogens infection and parasite activity will be monitored again as described for 2007. Survival of Japanese beetle grubs at all sites from October to May of each year will be analyzed to determine the impact of *O. popilliae* infection. Survival will be compared at sites with and without *O. popilliae*. Adults from each study site will also be collected and dissected again in 2008 to determine % infection and reduction in egg production due to *O. popilliae* infection. For the first time in 2008, a Japanese beetle field day will be held in late July and participants will be able to take home adult beetles heavily infected with *O. popilliae*. Data from 2007 indicates over 30% of the adult beetles are infected at some locations.

Impacts: Over 130 people from 20 different counties in Michigan came to our Japanese beetle biocontrol field day in Battle Creek in October, 2006 to collect infected grubs and take them back their own part of the state. We are planning another Biocontrol Field Day for October, 2008 in the Detroit area. The Kansas Department of Agriculture has initiated a new biocontrol program based on this research. Two KDA employees came to Michigan to collect infected grubs from one of our research sites in May, 2007, for introduction of the pathogen into Kansas. Populations of Japanese

beetle have already decreased enough at some sites in the Kalamazoo and Battle Creek areas that we are no longer seeing defoliation of linden trees and some superintendents are no longer treating all their fairways with insecticide to prevent grub damage. If what we have seen over the last 5 years is indicative of what we can expect in the future, sites where *O. popilliae* has been introduced will become heavily infected within 5 years and population of Japanese beetle will begin to decrease, until at 10 years after introduction insecticides may no longer be needed to protect linden trees from defoliation or fairway turf from dying in large patches.

Funding partners in 2007 and proposed for 2008:

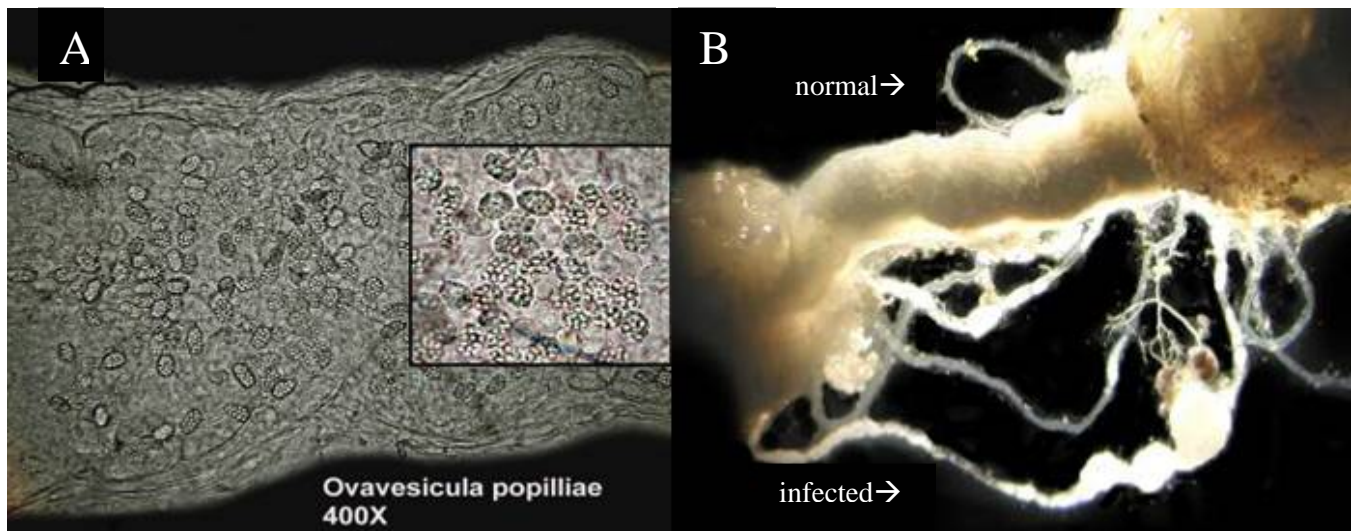
Project GREEN: \$40,000

Michigan Turfgrass Foundation: \$5,000

Figure 2. Adult Japanese beetle on a rose petal (A), *T. vernalis* larva feeding on a Japanese beetle grub (B), and *I. aldrichi* depositing an egg on the pronotum of a Japanese beetle.



Figure 3. *O. popilliae* infection of Japanese beetle can be diagnosed by the presence of raspberry-like spores in the malpighian tubules (A). Heavy infection causes knotting, swelling and dysfunction of the tubules (B).



Project Budget Form

Project GREEN FY-06 to FY-08

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